MDM-8249

FINAL
FIELD SAMPLING PLAN FOR ROTOSONIC DRILLING INVESTIGATION

OF THE
CAMP EDWARDS IMPACT AREA GROUNDWATER QUALITY STUDY

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

Prepared for

NATIONAL GUARD BUREAU
ARLINGTON, VIRGINIA

Prepared by

OGDEN ENVIRONMENTAL AND ENERGY SERVICES
239 Littleton Road, Suite 1B
Westford, Massachusetts 01886

July 18, 1997

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A.3 Field Sampling Plan for Rotosonic Rig Drilling

A.3.1 Background

A number of wells will be placed outside of the Impact Area and buffer zone in order to accomplish a number of investigation goals: (1) definition of the stratigraphy of the unconsolidated overburden; (2) evaluation of the water table configuration; and (3) monitoring of groundwater quality. In general, these wells are placed to optimize the achievement of these goals. For example, wells are distributed in space to evaluate the water table and stratigraphy over broad areas. Several wells are also placed at the suspected points of contact between the moraine deposits and the outwash materials. Monitoring wells are located within the estimated zones of contribution of planned groundwater production wells downgradient of the site. Finally, wells are placed in order to provide monitoring of groundwater quality downgradient of potential sources of contamination. The placement of these wells is the result of written comments on the Action Plan by US EPA, MA DEP, and interested parties. The locations were agreed upon in meetings with US EPA, MA DEP, and the US Geological Survey. The final location of some wells was discussed with USGS staff during reconnaissance of the site.

This set of monitoring wells will be completed using Rotosonic drilling technology. This technology allows for rapid completion of the well, continuous sampling of aquifer materials, and efficient sampling of groundwater. Unfortunately, the potential effect of Rotosonic drilling on unexploded ordnance is not clear. This makes its use problematic in areas where UXO may exist. Thus, Rotosonic drilling will be restricted to areas outside of the Impact Area and buffer zone.

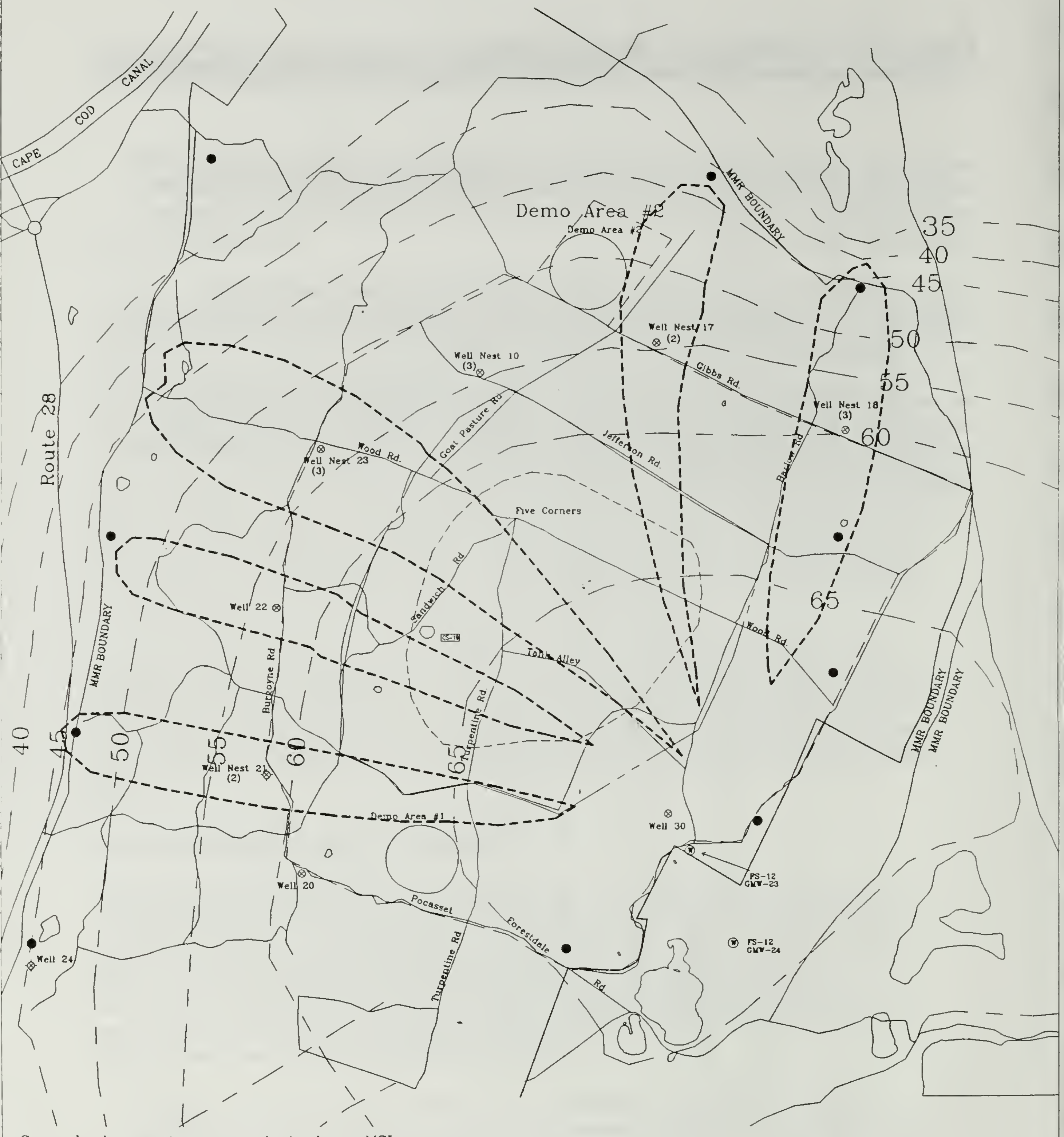
A.3.2 Sampling & Analysis Methods

The borings to be completed outside of the Impact Area and buffer zone will be produced by Rotosonic drilling as described in Section 4 of the Action Plan. The locations for the wells are presented on Figure A.3-1 and include MW-10, MW-17, MW-18, MW-20, MW-21, MW-22, MW-23, MW-24, and MW-30. The separate locations are numbered and the number of well screens to be completed at each location is noted. Depending on the location, well nests (i.e., two or three screens) or single wells are planned. The estimated zones of contributions to the planned production wells are also noted on the figure.

The sampling protocol (i.e., soil screening as well as laboratory analysis of soils and groundwater) to be executed at each of the wells is presented as Table A.3-1. The strategy for sampling of soils and groundwater is defined in the Final Action Plan (see Section 4 and the referenced protocols). Sample collection will be consistent with MMR SOPs, the Ogden Health and Safety Guidelines, Attachment A: Field Guide to High Explosives, and the EPA Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities (October 31, 1996).

In the unsaturated zone, ten foot samples will be collected in a ten foot plastic core bag continuously for lothologic logging and FID screening. Each sample registering a response by the FID will be analyzed for non-explosive organic compounds.

Groundwater samples will be collected every ten feet during advancement of the borings in the saturated zone and will be submitted for laboratory analysis of explosives and VOCs. Wells will be screened as described in Section 4.2.2 of the Action Plan. Deep borings will be advanced to bedrock which will be confirmed by 15 feet of coring.



Groundwater contours are feet above MSL

⊗ Proposed Permanent Investigation Well Locations

◈ Bedrock Boring Locations

● Long Range Water Supply

⊛ IRP Investigation Wells Included in the Groundwater Study

Source: USGS Modeling and Analysis, 1994

FIGURE A.3–1
ROTOSONIC DRILLING LOCATIONS

OGDEN ENVIRONMENTAL AND ENERGY SERVICES

239 LITTLETON ROAD
WESTFORD, MASSACHUSETTS 01886

TELEPHONE: 508-692-9090
FASCIMILE: 508-692-6633

Table A.3-1: Samples to Be Collected from Rotosonic Drilling Locations

MMR Subsurface Soil Samples from Borings					Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Loc.	Depth	MMR ID	Ogden ID	Cont.	8oz	8oz	8oz		4oz	8 oz.			4oz	
Outside the Buffer Zone - x = sample only intervals with response from FID															
	MW10	A	71MS10DXAX01XA	S10DAA						x	x	x	x	x	x
		B	71MS10DXBX01XA	S10DBA						x	x	x	x	x	x
		C	71MS10DXCX01XA	S10DCA						x	x	x	x	x	x
		D	71MS10DXDX01XA	S10DDA						x	x	x	x	x	x
		E	71MS10DXEX01XA	S10DEA						x	x	x	x	x	x
		F	71MS10DXFX01XA	S10DFA						x	x	x	x	x	x
		G	71MS10DXGX01XA	S10DGA						x	x	x	x	x	x
		H	71MS10DXHX01XA	S10DHA						x	x	x	x	x	x
		I	71MS10DXIX01XA	S10DIA						x	x	x	x	x	x
		J	71MS10DXJX01XA	S10DJA						x	x	x	x	x	x
		K	71MS10DXKX01XA	S10DKA						x	x	x	x	x	x
		L	71MS10DXLX01XA	S10DLA						x	x	x	x	x	x
		M	71MS10DXMX01XA	S10DMA						x	x	x	x	x	x
	MW17	A	71MS17DXAX01XA	S17DAA						x	x	x	x	x	x
		B	71MS17DXBX01XA	S17DBA						x	x	x	x	x	x
		C	71MS17DXCX01XA	S17DCA						x	x	x	x	x	x
		D	71MS17DXDX01XA	S17DDA						x	x	x	x	x	x
		E	71MS17DXEX01XA	S17DEA						x	x	x	x	x	x
		F	71MS17DXFX01XA	S17DFA						x	x	x	x	x	x
		G	71MS17DXGX01XA	S17DGA						x	x	x	x	x	x
		H	71MS17DXHX01XA	S17DHA						x	x	x	x	x	x
		I	71MS17DXIX01XA	S17DIA						x	x	x	x	x	x
		J	71MS17DXJX01XA	S17DJA						x	x	x	x	x	x
		K	71MS17DXKX01XA	S17DKA						x	x	x	x	x	x
		L	71MS17DXLX01XA	S17DLA						x	x	x	x	x	x
		M	71MS17DXMX01XA	S17DMA						x	x	x	x	x	x
	MW18	A	71MS18DXAX01XA	S18DAA						x	x	x	x	x	x
		B	71MS18DXBX01XA	S18DBA						x	x	x	x	x	x
		C	71MS18DXCX01XA	S18DCA						x	x	x	x	x	x
		D	71MS18DXDX01XA	S18DDA						x	x	x	x	x	x
		E	71MS18DXEX01XA	S18DEA						x	x	x	x	x	x
		F	71MS18DXFX01XA	S18DFA						x	x	x	x	x	x
		G	71MS18DXGX01XA	S18DGA						x	x	x	x	x	x
		H	71MS18DXHX01XA	S18DHA						x	x	x	x	x	x
		I	71MS18DXIX01XA	S18DIA						x	x	x	x	x	x
		J	71MS18DXJX01XA	S18DJA						x	x	x	x	x	x
		K	71MS18DXKX01XA	S18DKA						x	x	x	x	x	x
		L	71MS18DXLX01XA	S18DLA						x	x	x	x	x	x
		M	71MS18DXMX01XA	S18DMA						x	x	x	x	x	x

Table A.3-1: Samples to Be Collected from Rotosonic Drilling Locations

MMR Subsurface Soil Samples from Borings					Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Loc.	Depth	MMR ID	Ogden ID	Cont.	8oz	8oz	8oz		4oz	8 oz.			4oz	
	MW20	A	71MS20DXAX01XA	S20DAA						X	X	X	X	X	X
		B	71MS20DXBX01XA	S20DBA						X	X	X	X	X	X
		C	71MS20DXCX01XA	S20DCA						X	X	X	X	X	X
		D	71MS20DXDX01XA	S20DDA						X	X	X	X	X	X
		E	71MS20DXEX01XA	S20DEA						X	X	X	X	X	X
		F	71MS20DXFX01XA	S20DFA						X	X	X	X	X	X
		G	71MS20DXGX01XA	S20DGA						X	X	X	X	X	X
		H	71MS20DXHX01XA	S20DHA						X	X	X	X	X	X
		I	71MS20DXIX01XA	S20DIA						X	X	X	X	X	X
		J	71MS20DXJX01XA	S20DJA						X	X	X	X	X	X
		K	71MS20DXKX01XA	S20DKA						X	X	X	X	X	X
		L	71MS20DXLX01XA	S20DLA						X	X	X	X	X	X
		M	71MS20DXMX01XA	S20DMA						X	X	X	X	X	X
	MW21	A	71MS21DXAX01XA	S21DAA						X	X	X	X	X	X
		B	71MS21DXBX01XA	S21DBA						X	X	X	X	X	X
		C	71MS21DXCX01XA	S21DCA						X	X	X	X	X	X
		D	71MS21DXDX01XA	S21DDA						X	X	X	X	X	X
		E	71MS21DXEX01XA	S21DEA						X	X	X	X	X	X
		F	71MS21DXFX01XA	S21DFA						X	X	X	X	X	X
		G	71MS21DXGX01XA	S21DGA						X	X	X	X	X	X
		H	71MS21DXHX01XA	S21DHA						X	X	X	X	X	X
		I	71MS21DXIX01XA	S21DIA						X	X	X	X	X	X
		J	71MS21DXJX01XA	S21DJA						X	X	X	X	X	X
		K	71MS21DXKX01XA	S21DKA						X	X	X	X	X	X
		L	71MS21DXLX01XA	S21DLA						X	X	X	X	X	X
		M	71MS21DXMX01XA	S21DMA						X	X	X	X	X	X
	MW22	A	71MS22DXAX01XA	S22DAA						X	X	X	X	X	X
		B	71MS22DXBX01XA	S22DBA						X	X	X	X	X	X
		C	71MS22DXCX01XA	S22DCA						X	X	X	X	X	X
		D	71MS22DXDX01XA	S22DDA						X	X	X	X	X	X
		E	71MS22DXEX01XA	S22DEA						X	X	X	X	X	X
		F	71MS22DXFX01XA	S22DFA						X	X	X	X	X	X
		G	71MS22DXGX01XA	S22DGA						X	X	X	X	X	X
		H	71MS22DXHX01XA	S22DHA						X	X	X	X	X	X
		I	71MS22DXIX01XA	S22DIA						X	X	X	X	X	X
		J	71MS22DXJX01XA	S22DJA						X	X	X	X	X	X
		K	71MS22DXKX01XA	S22DKA						X	X	X	X	X	X
		L	71MS22DXLX01XA	S22DLA						X	X	X	X	X	X
		M	71MS22DXMX01XA	S22DMA						X	X	X	X	X	X

Table A.3-1: Samples to Be Collected from Rotosonic Drilling Locations

MMR Subsurface Soil Samples from Borings					**Parameters:**	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	**Other Analytes:**	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	**Loc.**	**Depth**	**MMR ID**	**Ogden ID**	**Cont.**	8oz	8oz	8oz		4oz	8 oz.			4oz	
	MW23	A	71MS23DXAX01XA	S23DAA						X	X	X	X	X	X
		B	71MS23DXBX01XA	S23DBA						X	X	X	X	X	X
		C	71MS23DXCX01XA	S23DCA						X	X	X	X	X	X
		D	71MS23DXDX01XA	S23DDA						X	X	X	X	X	X
		E	71MS23DXEX01XA	S23DEA						X	X	X	X	X	X
		F	71MS23DXFX01XA	S23DFA						X	X	X	X	X	X
		G	71MS23DXGX01XA	S23DGA						X	X	X	X	X	X
		H	71MS23DXHX01XA	S23DHA						X	X	X	X	X	X
		I	71MS23DXIX01XA	S23DIA						X	X	X	X	X	X
		J	71MS23DXJX01XA	S23DJA						X	X	X	X	X	X
		K	71MS23DXKX01XA	S23DKA						X	X	X	X	X	X
		L	71MS23DXLX01XA	S23DLA						X	X	X	X	X	X
		M	71MS23DXMX01XA	S23DMA						X	X	X	X	X	X
	MW24	A	71MS24DXAX01XA	S24DAA						X	X	X	X	X	X
		B	71MS24DXBX01XA	S24DBA						X	X	X	X	X	X
		C	71MS24DXCX01XA	S24DCA						X	X	X	X	X	X
		D	71MS24DXDX01XA	S24DDA						X	X	X	X	X	X
		E	71MS24DXEX01XA	S24DEA						X	X	X	X	X	X
		F	71MS24DXFX01XA	S24DFA						X	X	X	X	X	X
		G	71MS24DXGX01XA	S24DGA						X	X	X	X	X	X
		H	71MS24DXHX01XA	S24DHA						X	X	X	X	X	X
		I	71MS24DXIX01XA	S24DIA						X	X	X	X	X	X
		J	71MS24DXJX01XA	S24DJA						X	X	X	X	X	X
		K	71MS24DXKX01XA	S24DKA						X	X	X	X	X	X
		L	71MS24DXLX01XA	S24DLA						X	X	X	X	X	X
		M	71MS24DXMX01XA	S24DMA						X	X	X	X	X	X
19	**MW30**	A	71MS30DXAX01XA	S30DAA						X	X	X	X	X	X
		B	71MS30DXBX01XA	S30DBA						X	X	X	X	X	X
		C	71MS30DXCX01XA	S30DCA						X	X	X	X	X	X
		D	71MS30DXDX01XA	S30DDA						X	X	X	X	X	X
		E	71MS30DXEX01XA	S30DEA						X	X	X	X	X	X
		F	71MS30DXFX01XA	S30DFA						X	X	X	X	X	X
		G	71MS30DXGX01XA	S30DGA						X	X	X	X	X	X
		H	71MS30DXHX01XA	S30DHA						X	X	X	X	X	X
		I	71MS30DXIX01XA	S30DIA						X	X	X	X	X	X
		J	71MS30DXJX01XA	S30DJA						X	X	X	X	X	X
		K	71MS30DXKX01XA	S30DKA						X	X	X	X	X	X
		L	71MS30DXLX01XA	S30DLA						X	X	X	X	X	X
		M	71MS30DXMX01XA	S30DMA						X	X	X	X	X	X

Table A.3-1: Samples to Be Collected from Rotosonic Drilling Locations

MMR Groundwater Samples from Borings					Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Loc.	Depth	MMR ID	Ogden ID	Cont:	250mL									
					Pres:										
	MW21	A	71GB21DXAX01XA	G21DAA		X				X					
		B	71GB21DXBX01XA	G21DBA		X				X					
		C	71GB21DXCX01XA	G21DCA		X				X					
		D	71GB21DXDX01XA	G21DDA		X				X					
		E	71GB21DXEX01XA	G21DEA		X				X					
		F	71GB21DXFX01XA	G21DFA		X				X					
		G	71GB21DXGX01XA	G21DGA		X				X					
		H	71GB21DXHX01XA	G21DHA		X				X					
		I	71GB21DXIX01XA	G21DIA		X				X					
		J	71GB21DXJX01XA	G21DJA		X				X					
		K	71GB21DXKX01XA	G21DKA		X				X					
		L	71GB21DXLX01XA	G21DLA		X				X					
		M	71GB21DXMX01XA	G21DMA		X				X					
		N	71GB21DXNA01XA	G21DNA		X				X					
		O	71GB21DXOB01XA	G21DOA		X				X					
	MW23	A	71GB23DXAX01XA	G23DAA		X				X					
		B	71GB23DXBX01XA	G23DBA		X				X					
		C	71GB23DXCX01XA	G23DCA		X				X					
		D	71GB23DXDX01XA	G23DDA		X				X					
		E	71GB23DXEX01XA	G23DEA		X				X					
		F	71GB23DXFX01XA	G23DFA		X				X					
		G	71GB23DXGX01XA	G23DGA		X				X					
		H	71GB23DXHX01XA	G23DHA		X				X					
		I	71GB23DXIX01XA	G23DIA		X				X					
		J	71GB23DXJX01XA	G23DJA		X				X					
		K	71GB23DXKX01XA	G23DKA		X				X					
		L	71GB23DXLX01XA	G23DLA		X				X					
		M	71GB23DXMX01XA	G23DMA		X				X					
		N	71GB23DXNA01XA	G23DNA		X				X					
		O	71GB23DXOB01XA	G23DOA		X				X					

Attachment A: Field Guide to High Explosives

Any substance encountered during sampling activities which differs in any way from the natural material will be treated as a dangerous substance, carefully removed from the sample and set aside.

Name	Properties	Stability
TNT	usually resembles light brown sugar, when pure it is a crystalline powder of very pale straw color	one of the most stable of high explosives, quite insensitive to blows or friction, but can be detonated by severe impact between metal surfaces
Ammonium Picrate	orange-yellow crystalline solid	the least sensitive to shock
Picric Acid	lemon-yellow crystalline solid	very sensitive to blows or friction - forms explosive salts, extremely sensitive to blows or friction
Tetryl	fine yellow crystalline powder	sensitive to blows or friction
Mercury Fulminate	white to faint yellowish brown or grayish tint crystalline solid	sensitive to blows or friction
Amatol	plastic mass resembling wet brown sugar	

Other compounds with no available description which may be encountered and should be treated as a dangerous substance:

Lead Azide
PETN
HMX
RDX
Ednatol
Magnesium
Propellant

Composition B
Composition C3
Composition C4
Octol
Tracer Compound
Lead Styphuate
White Phosphorus

Composition A
Pentolite (50/50)
PBX
Tetrytol
Black Powder
Ammonium Nitrate

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